# PAGTANAW 2050

## THE PHILIPPINE FORESIGHT

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# A PREVIEW — PAGTANAW 2050: THE PHILIPPINE SCIENCE, TECHNOLOGY, AND INNOVATION FORESIGHT

## Introduction

The Department of Science and Technology (DOST) has always pushed for the country's scientific and technological advancement. On the other hand, the National Academy of Science and Technology, Philippines (NAST PHL) has served as primary adviser to government on matters related to science and technology and has actively worked towards developing a truly Filipino productive science culture.

In 2019, DOST Secretary Fortunato T. De La Peña challenged NAST PHL to undertake a foresight study, similar to the Malaysia's Outlook 2050 crafted by the Akademi Sains Malaysia. The NAST PHL's proposal to develop a 30-year STI Foresight, including strategic plans, was quickly approved for funding by the DOST Executive Committee the following year. The NAST PHL was able to complete the first and second versions of the country's STI Foresight document, aptly entitled PAGTANAW 2050, or LOOKING AHEAD 2050, despite the technical and other unprecedented difficulties brought about by the COVID-19 pandemic.

PAGTANAW 2050 is the first DOST-funded inter-disciplinal and trans-disciplinal project on Philippine-focused STI Foresight and Strategic Plan that will impact on the aspirations of the Filipino people by 2050. It is a compendium of STI megatrends, global and national societal goals, transdisciplinary, and interdisciplinary operational areas, and current and emerging technologies relevant to the nation's development that is firmly grounded in the Filipino people's aspirations within the context of the natural and physical endowments as well as shared Filipino values and skills, and other potentials.

The said document also delves into probable and significant drivers of change, and provides insights and reflections on the plausible development paths towards achieving the Filipino aspirations as expressed in the 1987 Philippine Constitution, the various Philippine Development Plans, the United Nations Sustainable Development Goals (SDGs), the Department of Science and Technology Harmonized National Research and Development Agenda, and the National Economic Development Authority's vision for the Filipino people, AmBisyon Natin 2040 (NEDA, 2016).

At the core of this Foresight are 12 key operational areas, namely: Blue Economy; Governance; Business and Trade; Digital Transformation and Information and Communications Technology; Science Education and Talent Retention; Food Security and Nutrition; Health Systems; Energy; Water; Environment and Climate Change; Shelter, Transportation, and Other Infrastructure; and Space Exploration. It is hoped that the S&T aspirations of the Filipino people will be achieved by 2050 through this Foresight

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PAGTANAW 2050 envisions **harnessing the talent and tools in science and technology to innovate towards a prosperous, archipelagic, maritime nation by 2050.**

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# PAGTANAW 2050: THE PHILIPPINE SCIENCE, TECHNOLOGY, AND INNOVATION FORESIGHT

## EXECUTIVE SUMMARY

### Towards a Prosperous, Archipelagic, Maritime Nation

As the Philippines moves into the future, it faces challenges both old and new: the country continues to struggle with poverty alleviation even as it faces the challenges of the ongoing COVID-19 pandemic as well as the looming threats of climate change and regional geopolitics, among others. In 2018 alone, it is estimated that close to one out of every five Filipinos lives below the poverty line. Meanwhile, the country's population is expected to burgeon from some 110 million people as of this writing to over 144 million by 2050. Science, technology, and innovation (STI) will be fundamental in addressing these complex and interrelated problems—hence the need for this Pagtanaw 2050.

This Foresight underscores the archipelagic nature of our country and its implications and potentials for development: with 220 million hectares of marine environment and 29.8 million hectares of land, the Philippines' many societies and cultures have been mostly coastal in nature. Moreover, some 60% of the population resides along the coast, with a long history of use of the marine environment and resources. The observations, aspirations, and recommendations contained in this Foresight are firmly grounded on a shared vision of a Prosperous, Archipelagic, Maritime Nation.

The full measure of the intellectual weight of the National Academy of Science and Technology's experts, thought leaders, and allies across various fields has been brought to bear on this Foresight. We are thankful for the copious time that they volunteered and their in-depth participation in the many phases of this project—from comprehensive reference scanning and the Delphi method, to focused group discussions and scenario planning, and beyond. From these emerged many diverse perspectives, trends, opportunities, and particularly valuable insights on STI at both the national and international levels.

### Marine Resources, Maritime Heritage, and Science, Technology, and Innovation

We look back on our long maritime history and close relationship with the marine environment, from our precolonial balangays of centuries ago to today, with respect and an eye to the future. STI empowers our maritime traditions to encompass both the old and new: for example, a multi-hull "trimaran" boat, inspired by traditional designs yet powered by hybrid sources, was recently designed and built locally for passenger and cargo transport. Such innovations, informed by local culture and traditions but with modernity and the future in mind, should be further encouraged and supported towards the realization of a comprehensive Philippine Nautical Highway. The judicious planning and development of land, coastal, and marine resources through STI can

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facilitate the economical and efficient operation of shipbuilding and other industries. Further, our vast marine waters lend themselves perfectly to renewable energy initiatives that tap into waves, tides, thermal vents, and other natural marine resources. And, though our societies have progressed over the centuries, our vulnerabilities have only escalated: fisheries, aquaculture, and coastal industries are beset by increasingly severe seasonal typhoons. Climate change impacts such as stronger winds, excessive rainfall, and ocean acidification have made things worse. This situation is further aggravated by physical impairments from land reclamation and from chemical and solid waste pollution from watersheds. These problems call for integrated and harmonious planning and development via a "Highlands-to-Oceans" approach to land, coastal, and marine management, which should be a top government priority. The modernization of Philippine fisheries and aquaculture and the proper maintenance of Marine Protected Areas, are extremely potent in increasing marine productivity and the well-being of marine biodiversity. For example, our Marine Genetic Resources (MGRs)— situated as they are within the Coral Triangle, a global center of marine biodiversity—can potentially produce novel biologically active compounds for various pharmaceutical and other purposes. MGRs from marine organisms like bacteria, fungi, algae, other plants, and animals should thus be screened, studied, and isolated for drugs that have anti-pain, anti-infection, and anti-cancer effects. Further, while the extraction of minerals and other materials from our seas could be profitable and gainful if sustainably managed, other benefits and costs—to both the public and private sector—should be factored into the calculus of their exploitation.

The Philippines also boasts almost a hundred seaports—all of which, though invaluable to society and the economy, could still be improved and modernized in order to make them disaster resilient. We also need to strengthen national maritime standards and compliance with regional and global maritime agreements and international maritime conventions; and embark on the development of a Coastal and Inland Waterways Transport System and a Maritime Innovation and Knowledge Center, among others.

In this Foresight, we have framed the nation's aspirations firmly within the context of our natural and physical endowments—an archipelago with abundant marine resources—as well as our shared Filipino values and skill sets, and other potentials. This STI Foresight builds on current national aspirations and goals as outlined in the 1987 Philippine Constitution, AmBisyon Natin 2040, the Philippine Development Plans, the United Nations (UN) Sustainable Development Goals (SDGs), and the DOST Harmonized National Research and Development Agenda (HNRDA).

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**Key Operational Areas, Clusters, and Foresighting**

At the core of this Foresight are 12 key operational areas, outlined below, which can enable the realization of our societal aspirations through a unified STI agenda:

**Blue Economy.** The "blue economy" approach is imperative in the Philippines, an archipelagic country with territorial seas that are twice the size of its total land area. Scientific and technological innovations are expected to play a crucial role in the preparation and implementation of a comprehensive action plan for a National Coast and Ocean Strategy.

**Governance.** Having effective and well-governed institutions are essential to establishing an environment of high rates of investment and improved workforce performance in both the public and private sectors. Strategic technologies can be harnessed for both the government and private sectors to provide quality services, minimize human errors, reduce unreasonable bureaucratic procedures and unnecessary expense, and ultimately achieve administrative efficiency and timely response.

**Business and Trade**. While the Philippines has yet to establish a track record of translating scientific research into commercial products, the prospects can be improved dramatically by considering the business community's fundamental capacity as both beneficiary and enabler of innovation. In particular, we should provide a level playing field for our agriculture, industry and service sectors whose processes are especially friendly to innovation and research and development (R&D). However, this will not happen if the high cost of doing business—which includes the cost of energy—stemming from the poverty of public goods is allowed to persist.

**Digital Technology/Information and Communications Technology.** In this section, information and communications technology (ICT) is seen as a linchpin for achieving proficiency in STI in the Philippines. The full realization of the benefits of ICT will necessitate a shift towards a robust and accessible Digital Ecosystem, in which Digitally Transformed entities interact with each other, mutually benefit each other, and promote the greater good. Technologies like blockchain, cognitive systems, robotics, and quantum computing including last-mile connectivity to serve users in rural and remote areas are required of this ecosystem.

**Science Education and Talent Retention**. The importance of the Science, Technology, Engineering, and Mathematics (STEM) system of education in producing competitive STEM talent in the Philippines is vital in enhancing, maintaining, and monitoring the knowledge infrastructure in STEM. We need to adopt new out-of-the-box pedagogies that emphasize learning by doing.

**Food Security and Nutrition.** This operational area highlights the ability of agriculture to increase and diversify production towards the improved nutritional status of the population through new and science-based food system paradigms. In order to achieve desired nutritional outcomes, a sustainable food system should be characterized by green and inclusive growth, economic and social progress, and resilience to multiple risks.

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**Health Systems.** Foresighting the Philippines' health STI is anchored in achieving an efficiently working and properly funded Universal Health Care Program, which addresses needs that are real, palpable, and which immediately improve human lives. At the moment of writing this Foresight, the Philippines' response is focused towards managing the COVID-19 pandemic. Many of the health system technologies accelerated by the pandemic are quite useful for strengthening the healthcare delivery system.

**Energy.** Since the Philippines is dependent on imported fossil fuel for its energy needs and the energy sector is among the major contributors to greenhouse gas emissions and climate change, it is essential for the country to transition to clean and affordable energy technologies to meet future needs. Priority should be given to solar, wind, and ocean waves energy systems, energy storage, smart grids and networks, biofuels, and energy from wastes.

**Water.** Water resources, water uses, and regional water quality, demand and supply in the Philippines must be managed with regard to their use for domestic water supply, irrigation, flood control, power generation, and pollution control. Clean technologies will be adopted to improve the delivery of affordable clean water, minimize or prevent the production of wastewater effluents, and reduce the cost of water and wastewater treatment.

**Environment and Climate Change.** The Philippines is a hazard-prone country and periodically suffers from extreme weather conditions, earthquakes, volcano eruptions, and other natural hazards. It is also one of the countries that are most vulnerable and at risk to climate change. Consistent with Goal 13 of the United Nations' Sustainable Development Goals, the Philippines must adopt global and local actions to combat climate change and manage its impacts by strengthening resilience and adaptive capacity to climate-related hazards and other natural hazards.

**Shelter, Transportation, and Other Infrastructure.** Secure shelter and good transport facilities are minimum basic needs that are fundamental to what Filipinos aspire for as "maginhawang buhay" (comfortable life) and "panatag na buhay" (secure life), as discussed in AmBisyon Natin 2040 and which still remains relevant within the extended 30-year timeframe of the Foresight. Considering the archipelagic setting and maritime nature of the country, the national aspiration to balance urban and rural development can only be achieved through the improvement of ports, roll-on-roll-off facilities, expressway and road networks, and public transport, coupled with a strategic combination of various water, land, and air transportation modes. Shelter is needed in different forms as residence, refuge, and building as a vital component in organizing smart communities in both urban and rural settings.

**Space Exploration.** Space-based technologies have important applications in communications, weather forecasting, disaster management, natural resources and land use management, and in monitoring the environment. Current upstream and downstream space initiatives and future plans on space technologies must continue to be enhanced.

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To facilitate the foresighting process, the above operational areas were grouped into four clusters that underscore their interrelatedness and interconnectivity: **Food, Nutrition, and Health; Water and Energy; Environment and Space Exploration; and Built Environments.** Over and above these clusters, the operational areas of Digital Technology/ICT, Blue Economy, Business and Trade, Climate Change, Governance, and Science Education and Talent Retention are considered critical influencers and enablers that cut across all operational areas.

The "Blue Economy" is an overarching operational area that highlights the Philippines' inherently archipelagic nature and resources, pointing towards the sustainable use of marine resources—living and non-living—for the improvement of people's livelihoods while preserving the overall health of our marine ecosystems.

## 'Black Swans' and Hope for the Future

Integrative and future-responsive resilience is fundamental to this Foresight, as it should be for all development plans now and into perpetuity. Particularly relevant to this Foresight is the careful consideration and development of upcoming STI for the provision of goods and services; and land, coastal, and marine planning. This proactive stance is vital not just for anticipated crises such as typhoons and earthquakes, but also for unforeseen crises such as pandemic outbreaks and threats to water safety and security—all of which can all too easily stem from the mismanagement of marine and other resources. Hence, we include in this Foresight a cautionary but optimistic note on **Black Swans:** the threat of unpredictable future shocks—whether truly exogenous or stemming from the country's still developing institutional framework, human capital, and innovation capacity—can be subverted into positive drivers and opportunities: the proper development and implementation of plans to meet long-term integrative goals can do this.

In this regard, it is imperative to have proper governance at all levels and a whole-of-government approach anchored in STI and doing away with "business as usual" approaches at every turn. This necessitates a comprehensive and iterative review of laws, policies, and guidelines, so as to eliminate gaps, contradictions, and redundancies on the way to inclusive Philippine prosperity that makes full sustainable use of our natural endowments.

## Strategically Mapping the Future

This STI Foresight would be incomplete without an **STI Roadmap** to guide national development toward our preferred future. This unified and integrated map can be broken down into four complementary sub-maps—one for each of the previously-mentioned technology clusters—that visually trace the foresighted trajectories of the enablers, drivers, and opportunities that are seen to shape Philippine STI for the next three decades (Figures 1-5).

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Given the current pandemic, the Food, Nutrition, and Health map highlights the present emphasis on harnessing technologies towards providing universal healthcare and ensuring affordable and nutritious food through a transformation of food systems practices; artificial intelligence and ICT are seen to eventually play dominant roles in decision-making for health and nutrition. The roadmap for Energy and Water sees the emerging dominance of low-cost, large-scale renewable energy technologies and sources. Meanwhile, the map for Environment and Space Exploration outlays the path towards an improved capability to mitigate or altogether prevent natural hazards and disasters by utilizing appropriate, adaptive, and clean/green technologies; space technologies will play a key role in this regard, for monitoring large-scale patterns for assessing climate resiliency and environmental protection. Lastly, the Built Environments map plots the evolution of work and living spaces through the measured adoption of construction- and transportation-related technologies, such as smart materials and electric vehicles, all of which will be interconnected via ICT such as the Internet of Things and virtual/augmented reality.

Ultimately, the development of a globally-competitive Philippine knowledge economy with a maritime base will enable the Philippines to finally break out of its stagnation behind more scientifically-advanced nations, allowing it to grow from a mere service economy into the Prosperous, Archipelagic, Maritime Nation, united and inclusive as it was always meant to be.

**Source:**
NAST PHL 2021. Pagtanaw 2050: The Philippine Foresight on Science, Technology, and Innovation. National Academy of Science and Technology Philippines, Manila, 328 pp.

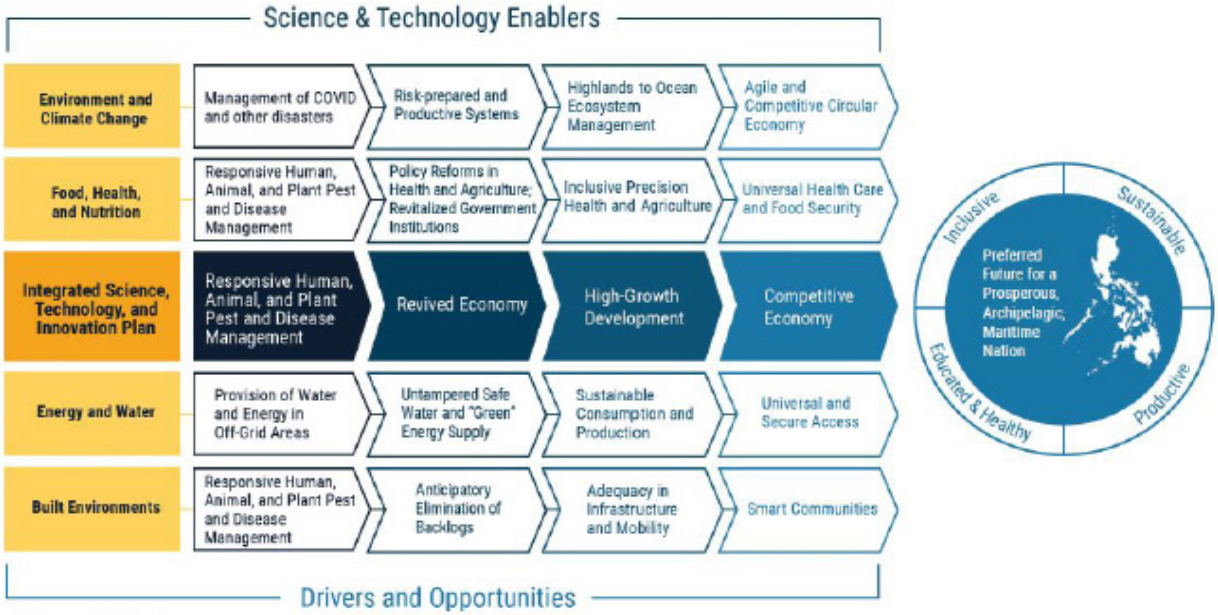


**Figure 6.2_1.** Integrated STI Roadmap

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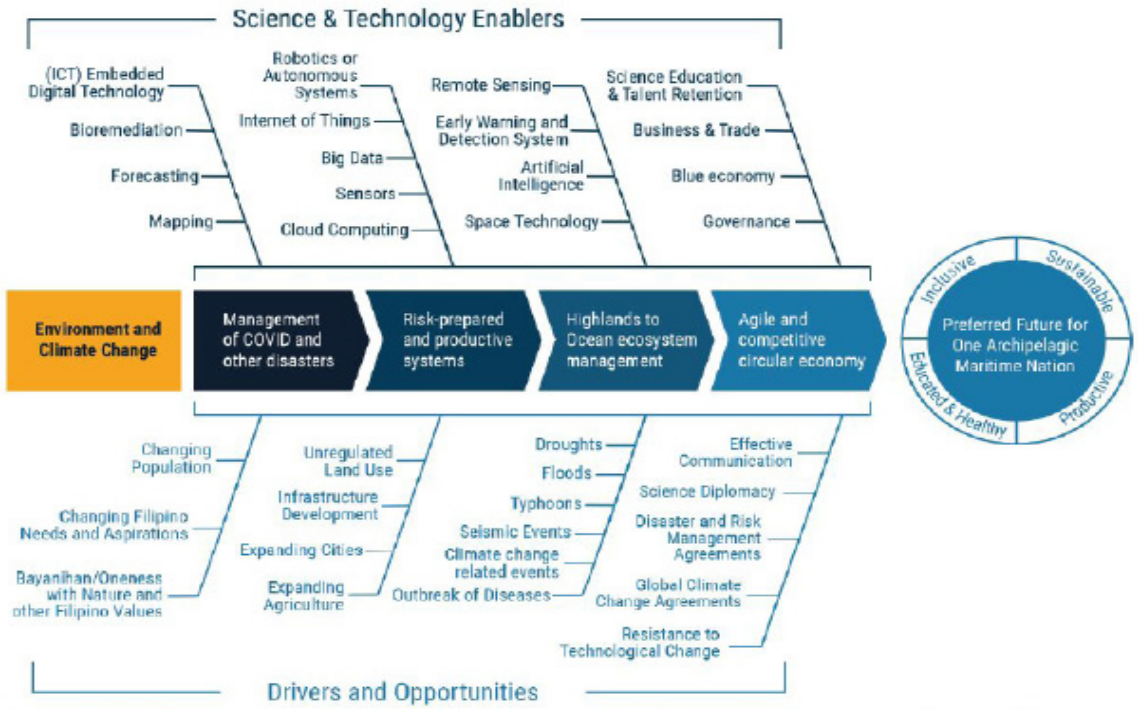


**Figure 6.2_2.** Environment, Climate Change, and Space Exploration Cluster Map

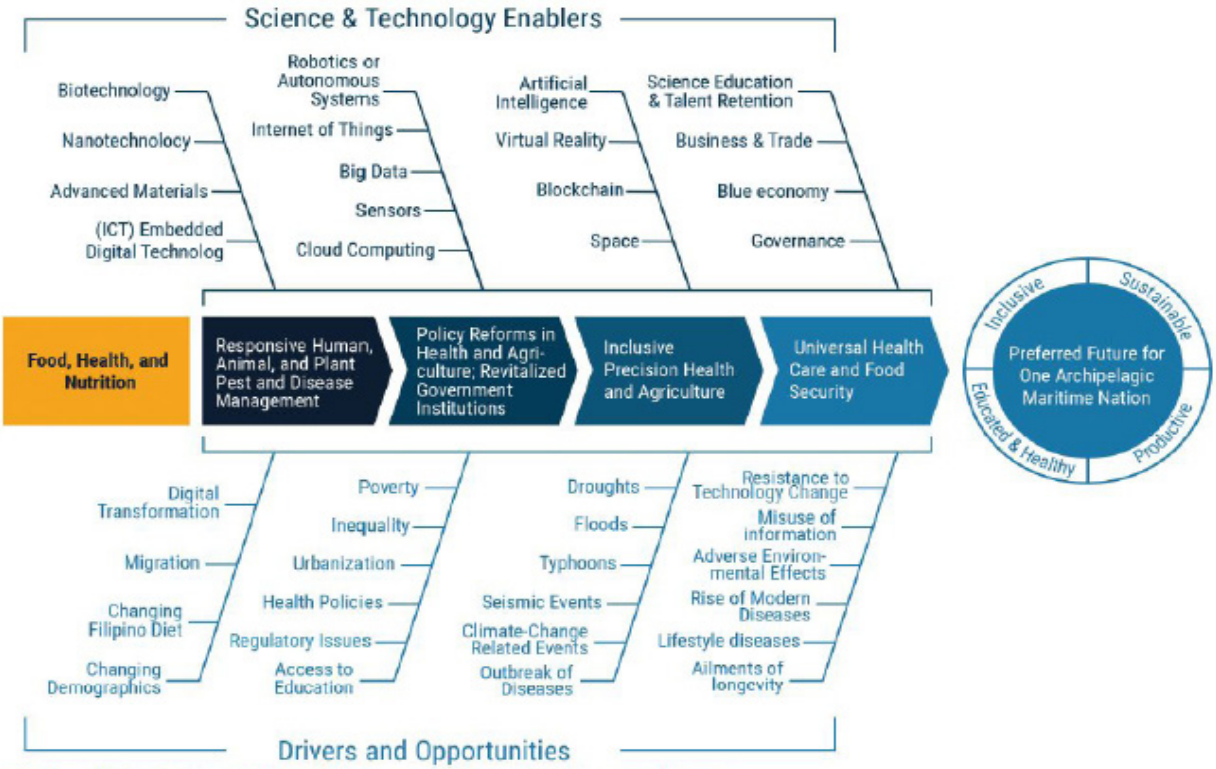


**Figure 6.2_3.** Food, Nutrition, and Health Cluster Map

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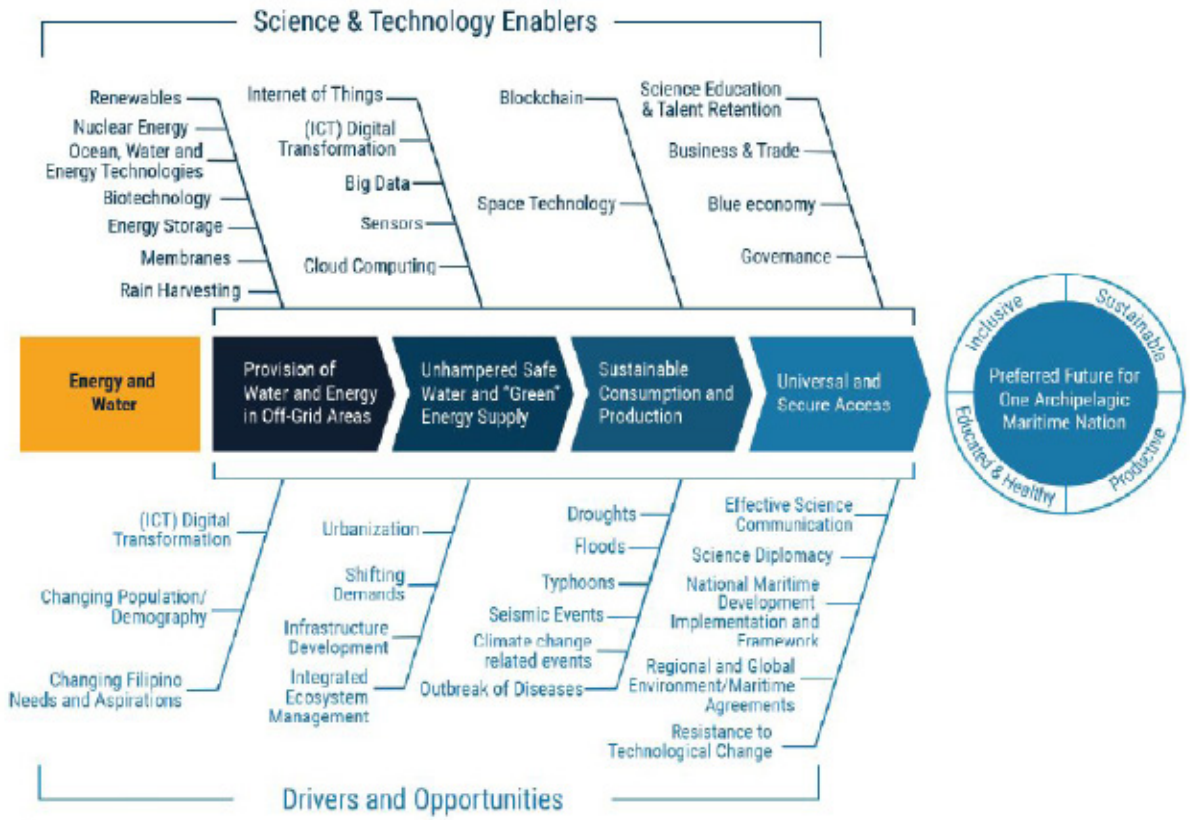


**Figure 6.2_4.** Energy and Water Cluster Map

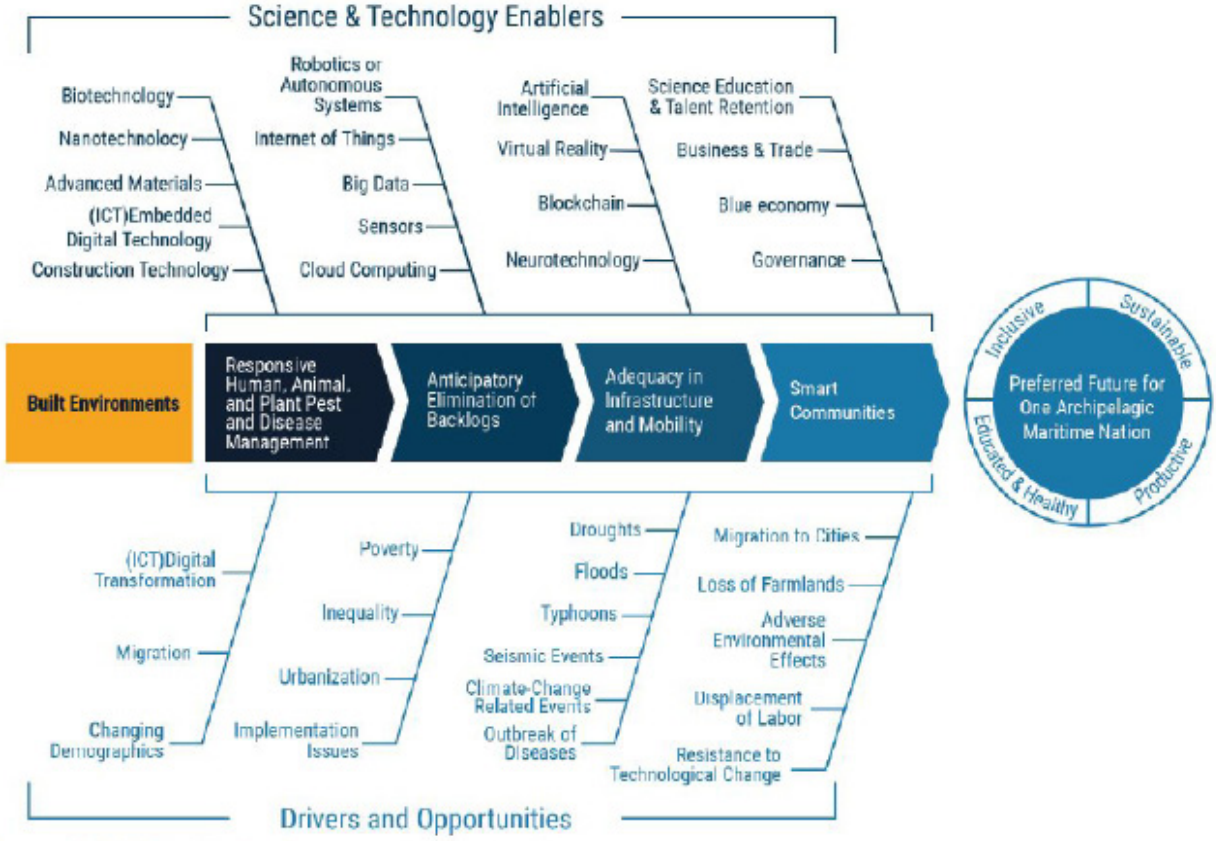


**Figure 6.2_5.** Built Environments Cluster Map